Stabilization of vortex beams in Kerr media by nonlinear absorption

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Résumé en anglais	We elaborate a solution for the problem of stable propagation of transversely localized vortex beams in homogeneous optical media with self-focusing Kerr nonlinearity. Stationary nonlinear Bessel-vortex states are stabilized against azimuthal breakup and collapse by multiphoton absorption, while the respective power loss is offset by the radial influx of the power from an intrinsic reservoir. A linear stability analysis and direct numerical simulations reveal a region of stability of these vortices. Beams with multiple vorticities have their stability regions too. These beams can then form robust tubular filaments in transparent dielectrics as common as air, water, and optical glasses at sufficiently high intensities. We also show that the tubular, rotating, and specklelike filamentation regimes, previously observed in experiments with axicon-generated Bessel beams, can be explained as manifestations of the stability or instability of a specific nonlinear Bessel-vortex state, which is fully identified.
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